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Hashimoto

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(54) **IMAGE FORMING APPARATUS INCLUDING FIXING DEVICE**

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G03G 15/20 (2006.01)
G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/1623*** (2013.01); ***G03G 15/2035*** (2013.01); ***G03G 21/1685*** (2013.01)

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CPC G03G 15/2032; G03G 15/2035; G03G 15/2067; G03G 15/2071; G03G 21/1633; G03G 21/1647; G03G 21/1685; G03G 2221/1639; G03G 21/1623
USPC 399/122, 110
See application file for complete search history.

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(57) **ABSTRACT**

An image forming apparatus includes a housing, a conveying member, a nip member, an urging member, a changing portion, a first transmission portion, a motor, a second transmission portion, and a switching member. The urging member is configured to urge one of the conveying member and the nip member. The changing portion is configured to change an urging force of the urging member. The opening/closing member is configured to generate a moving force when being moved. The second transmission portion is configured to transmit drive force of the motor to the first transmission portion to generate the moving force. The switching member is configured to switch to one of a transmitting state and a cutoff state. The switching member interrupts the transmission of the drive force from the second transmission portion to the first transmission portion in the cutoff state.

11 Claims, 10 Drawing Sheets

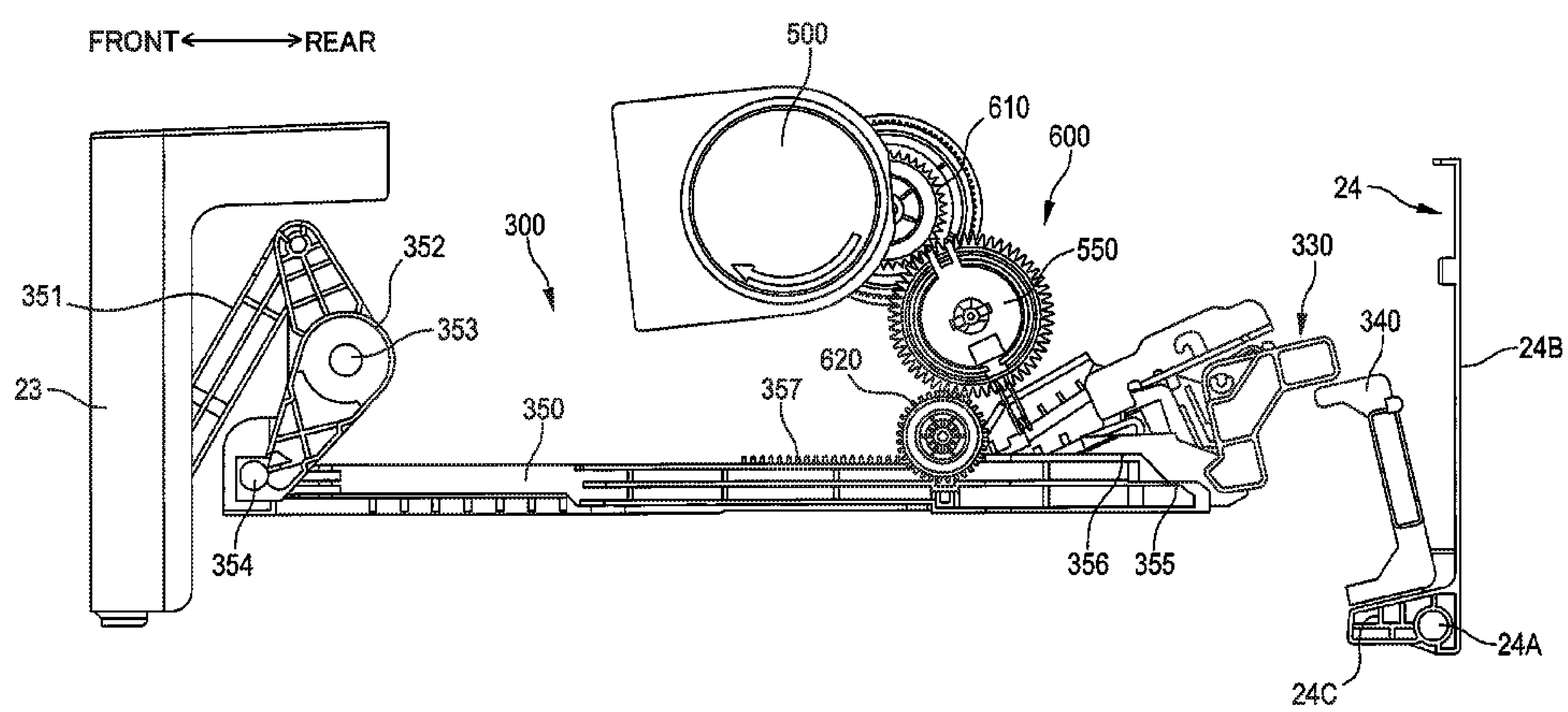

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FIG. 1

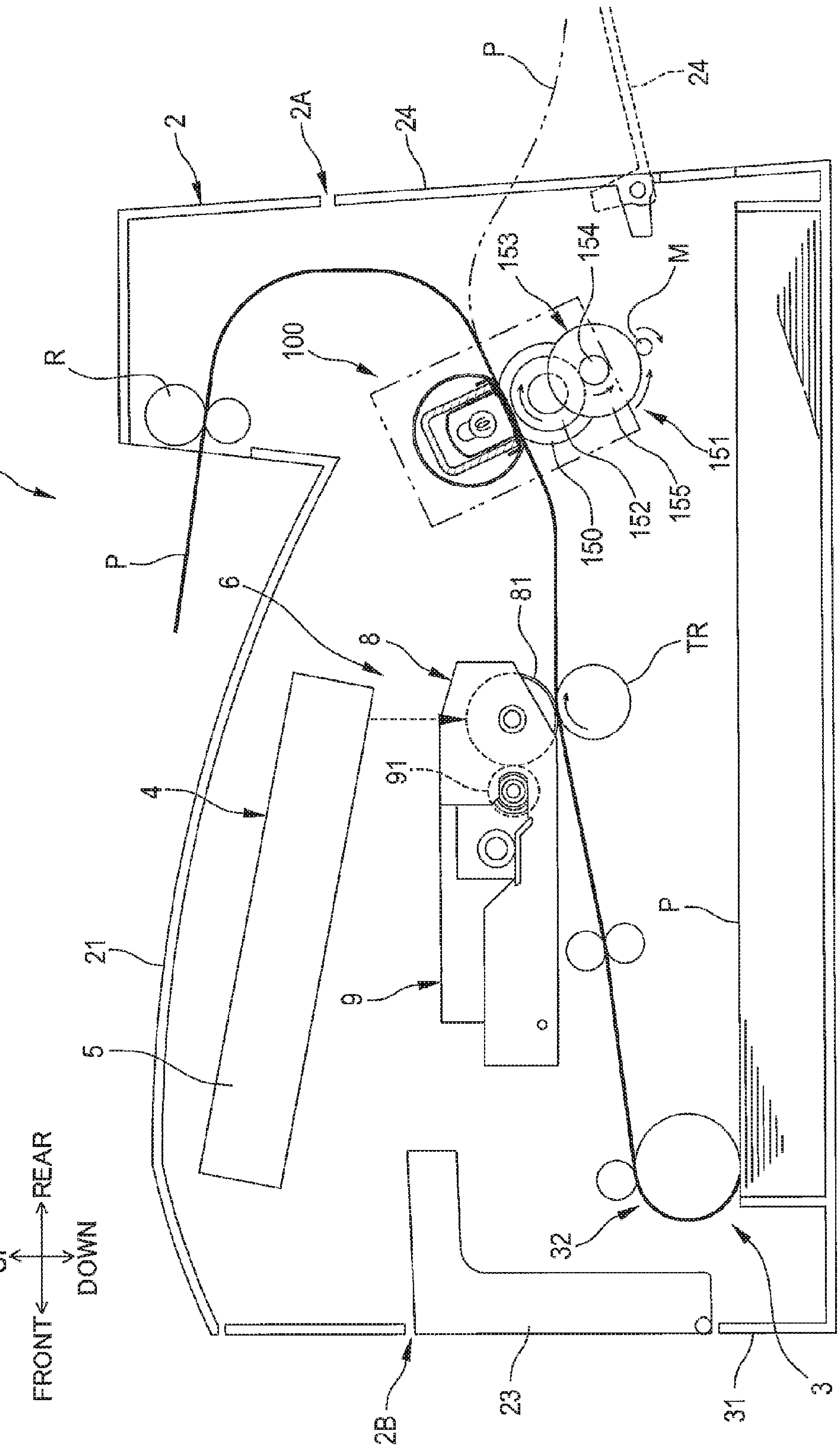

1
2
2A
24
P
R
100
153
154
M
151
155
152
150
6
8
81
TR
4
91
21
9
5
32
3
31
23
2B
UP
DOWN
FRONT
REAR

FIG. 2

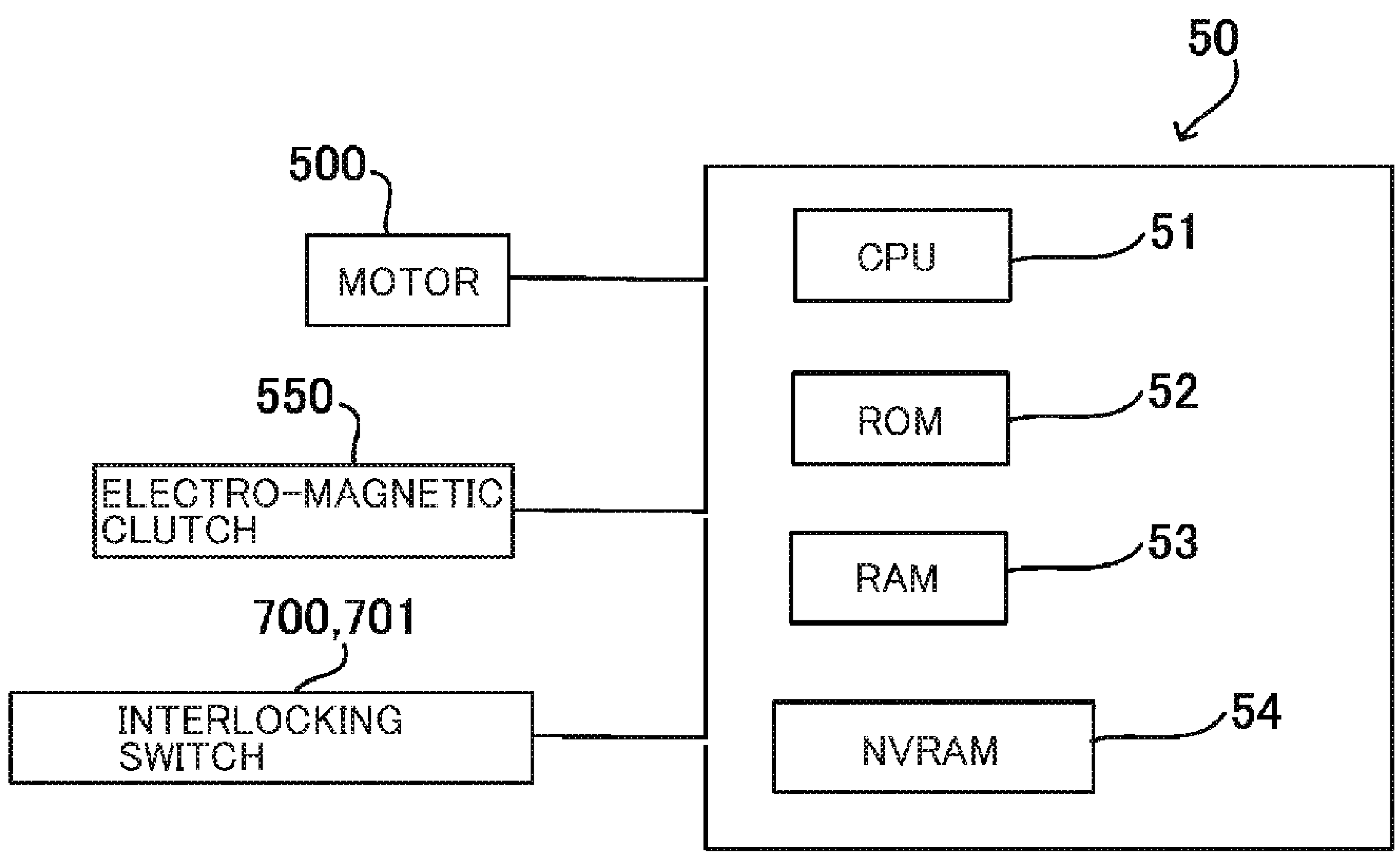

50
500
MOTOR
CPU
51
ROM
52
550
ELECTRO-MAGNETIC
CLUTCH
RAM
53
700,701
INTERLOCKING
SWITCH
NVRAM
54

FIG. 3

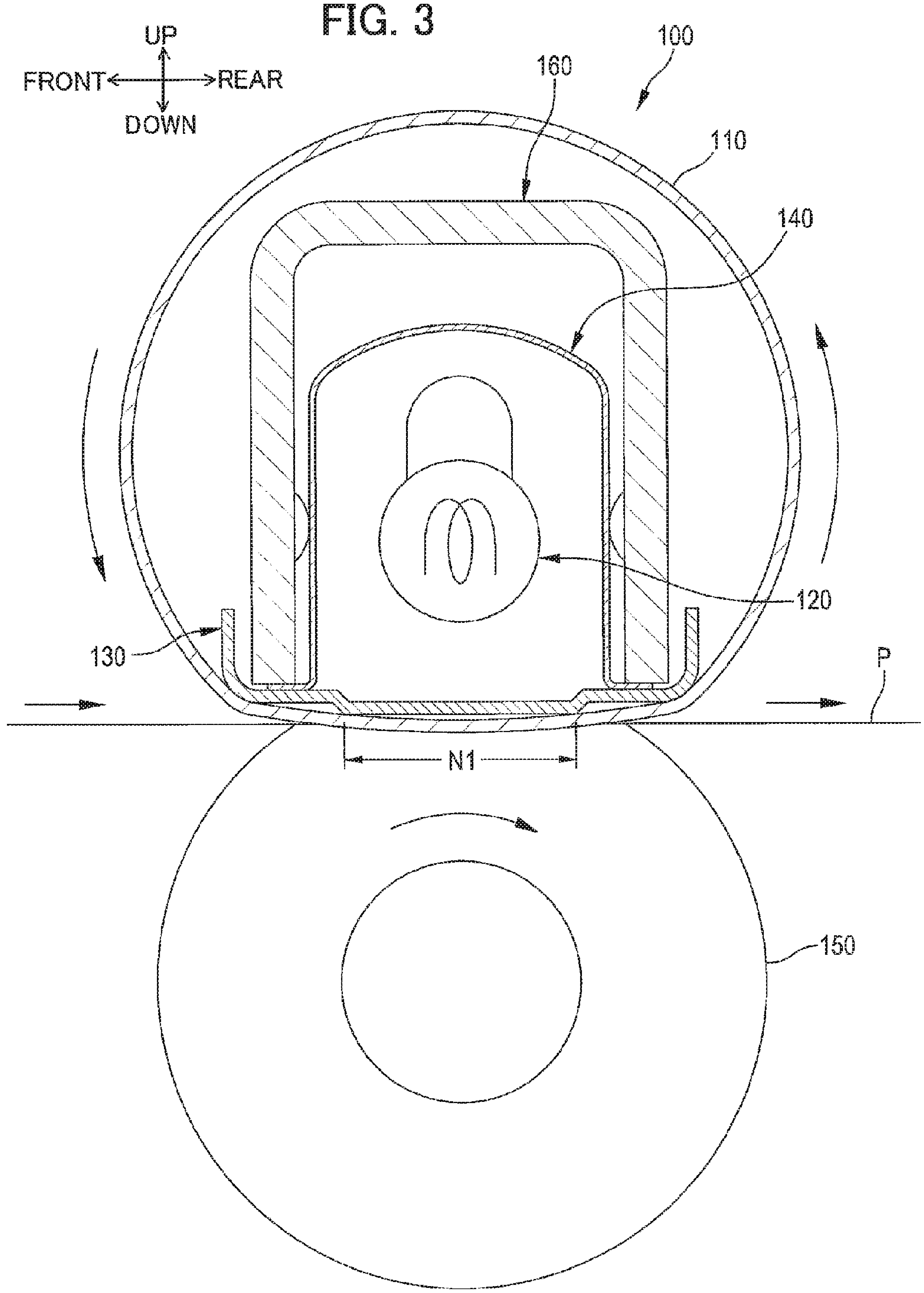
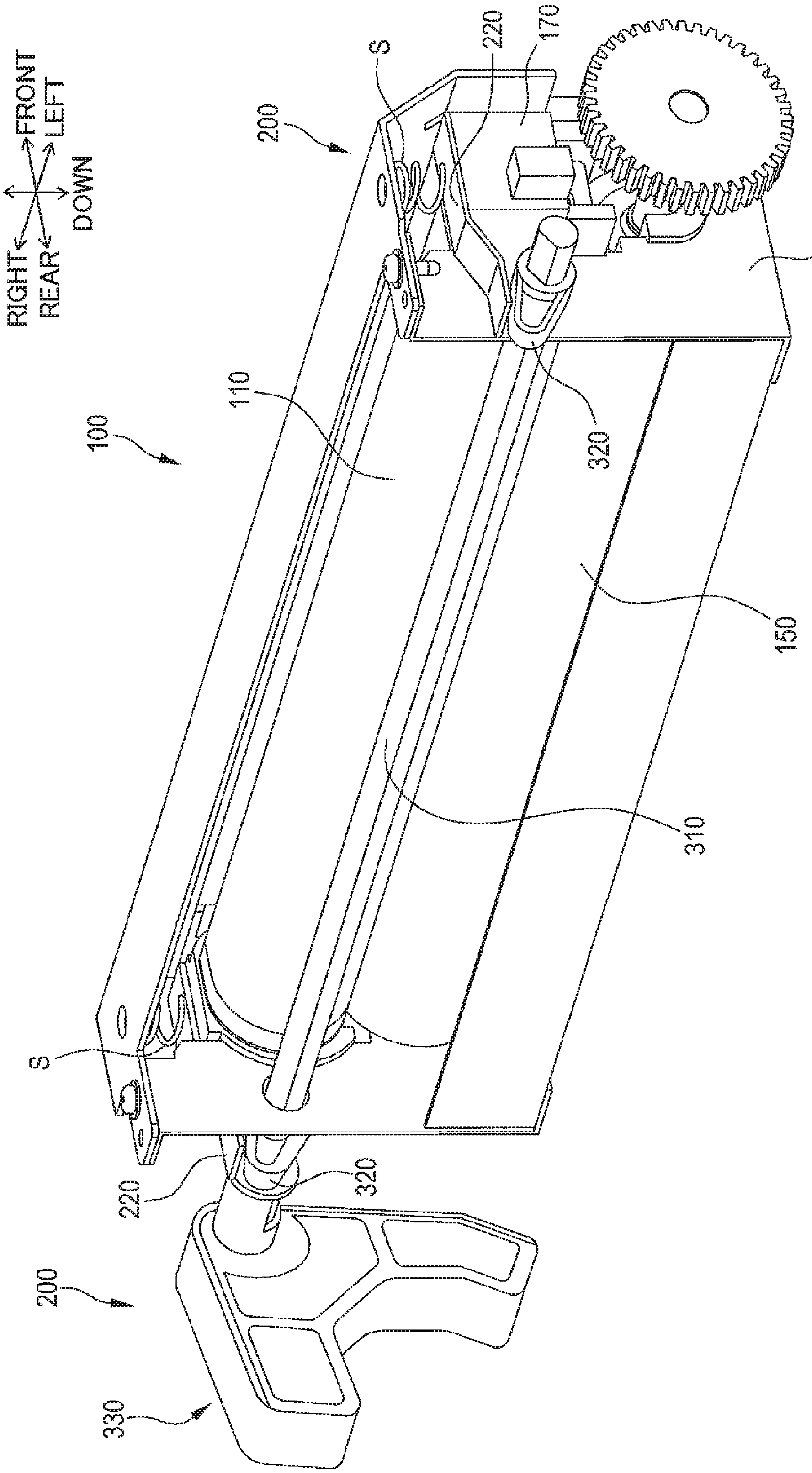


FIG. 4


UP
DOWN
FRONT
REAR
LEFT
RIGHT
200
S
220
170
210
110
100
320
150
310
S
220
320
200
330

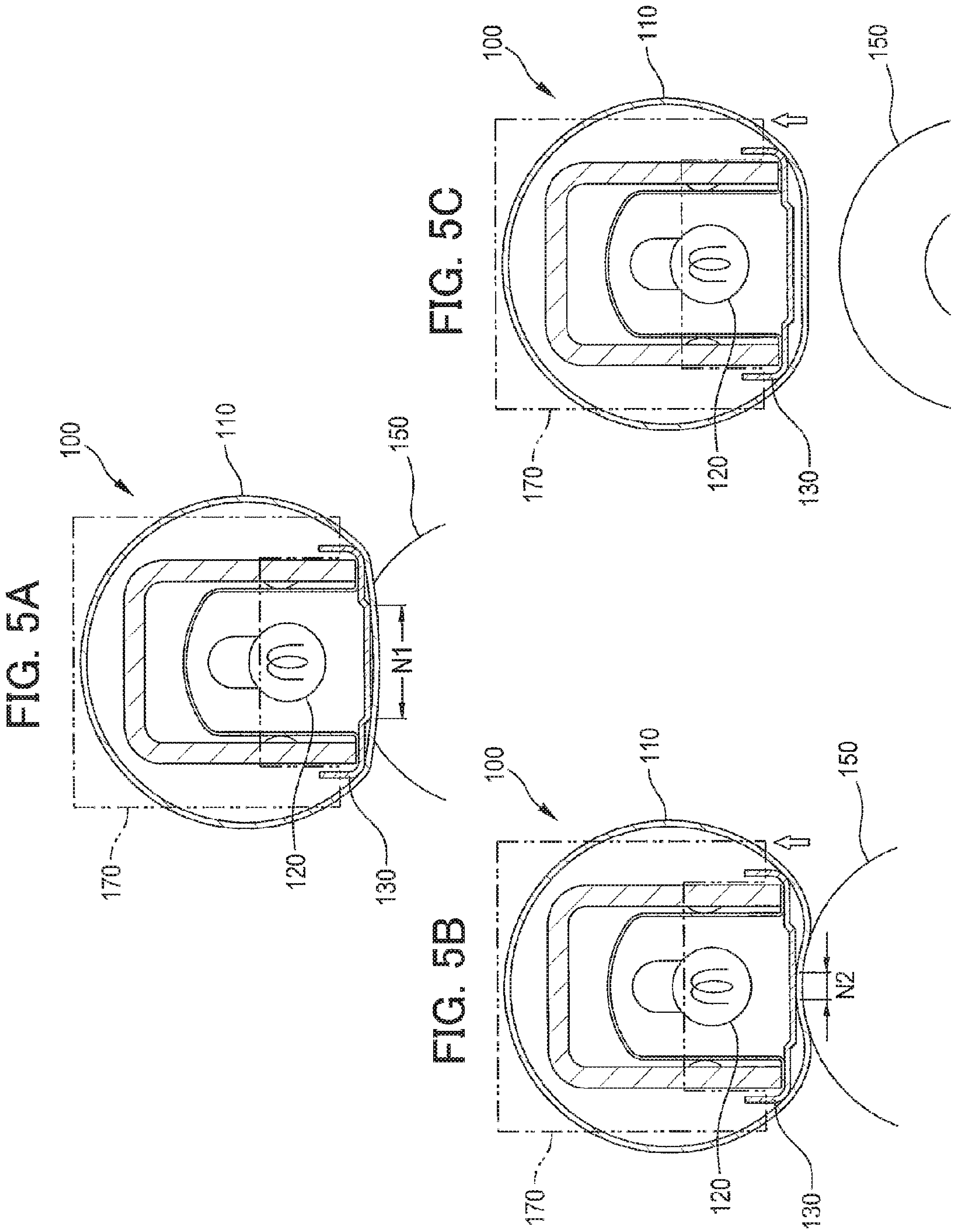
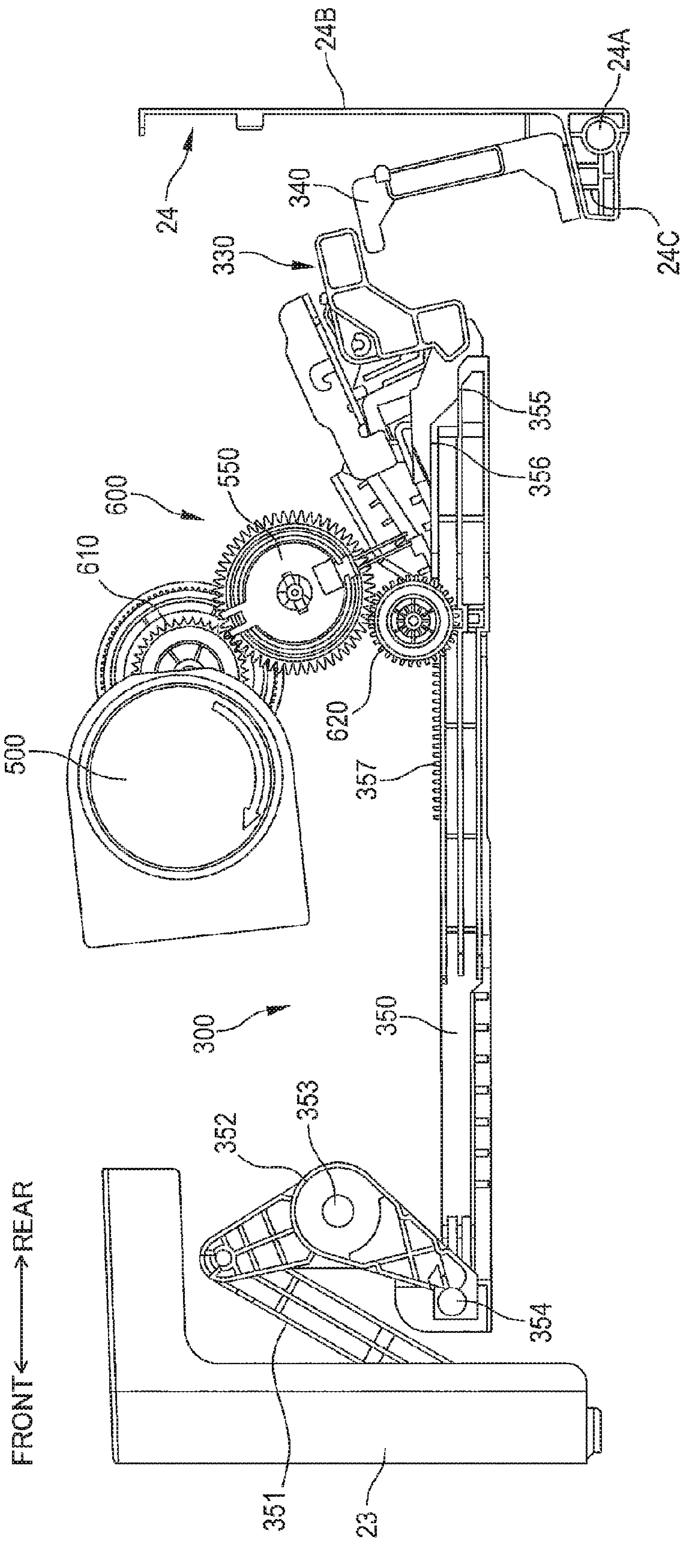


FIG. 5A

FIG. 5B

FIG. 5C

FIG. 6



24B
24A
24
340
24C
330
355
356
550
600
610
620
500
357
300
350
352
353
FRONT
REAR
354
351
23

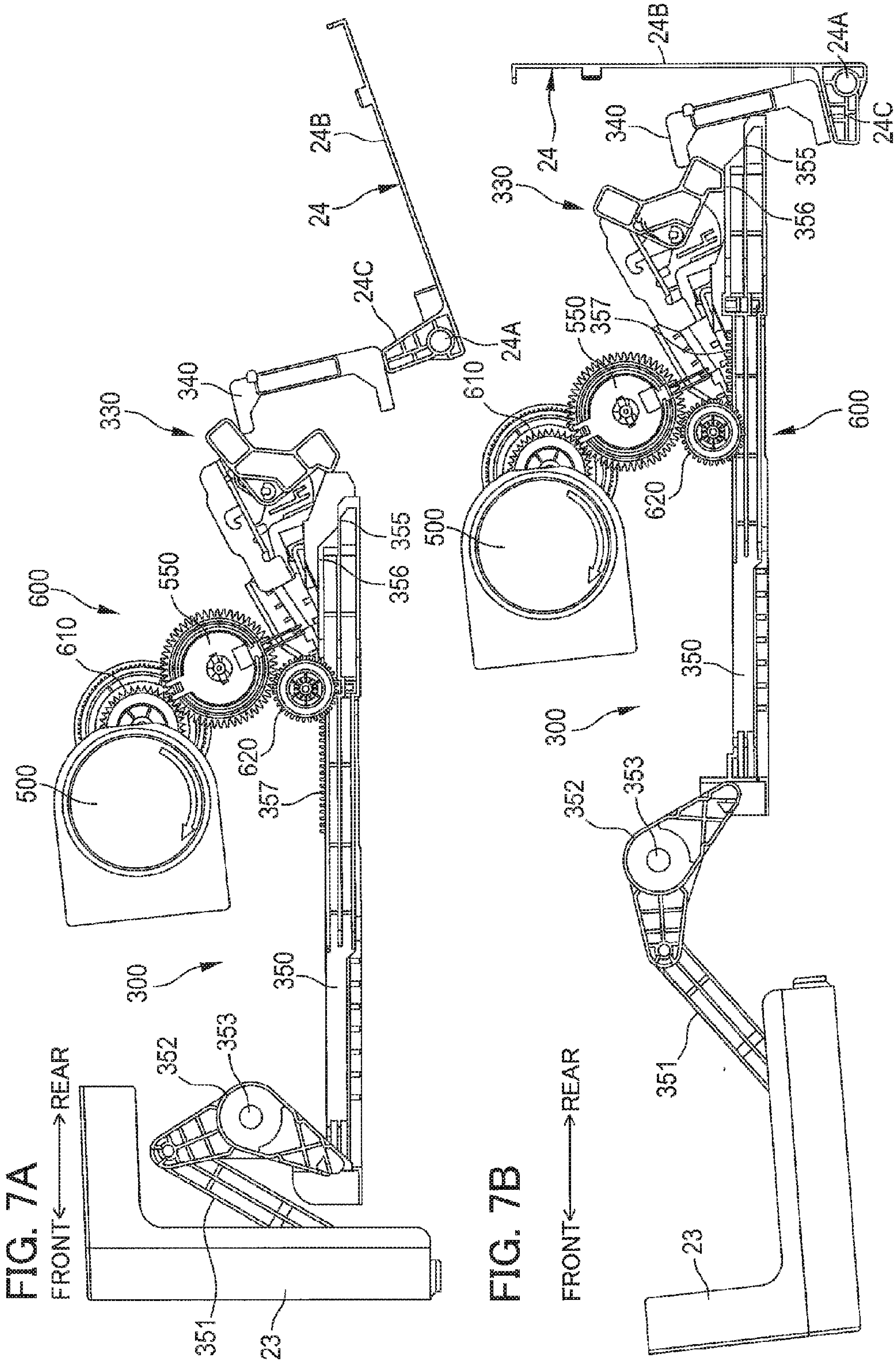
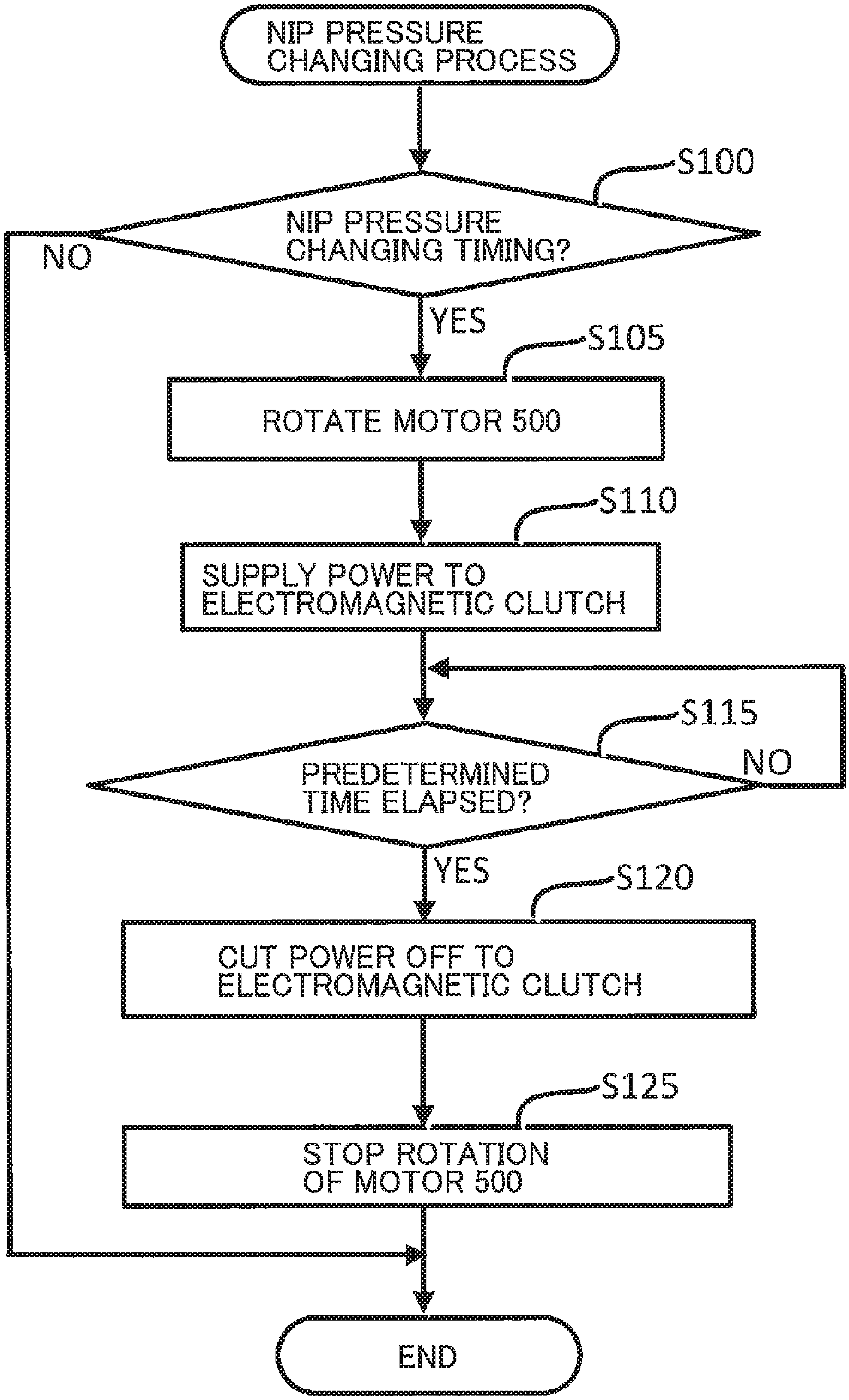

FRONT
REAR
23
351
352
353
300
350
357
500
620
610
600
550
356
355
330
340
24A
24C
24
24B

FIG. 7A

FIG. 7B

FIG. 8


NIP PRESSURE CHANGING PROCESS
S100
NIP PRESSURE CHANGING TIMING?
NO
YES
S105
ROTATE MOTOR 500
S110
SUPPLY POWER TO ELECTROMAGNETIC CLUTCH
S115
PREDETERMINED TIME ELAPSED?
NO
YES
S120
CUT POWER OFF TO ELECTROMAGNETIC CLUTCH
S125
STOP ROTATION OF MOTOR 500
END

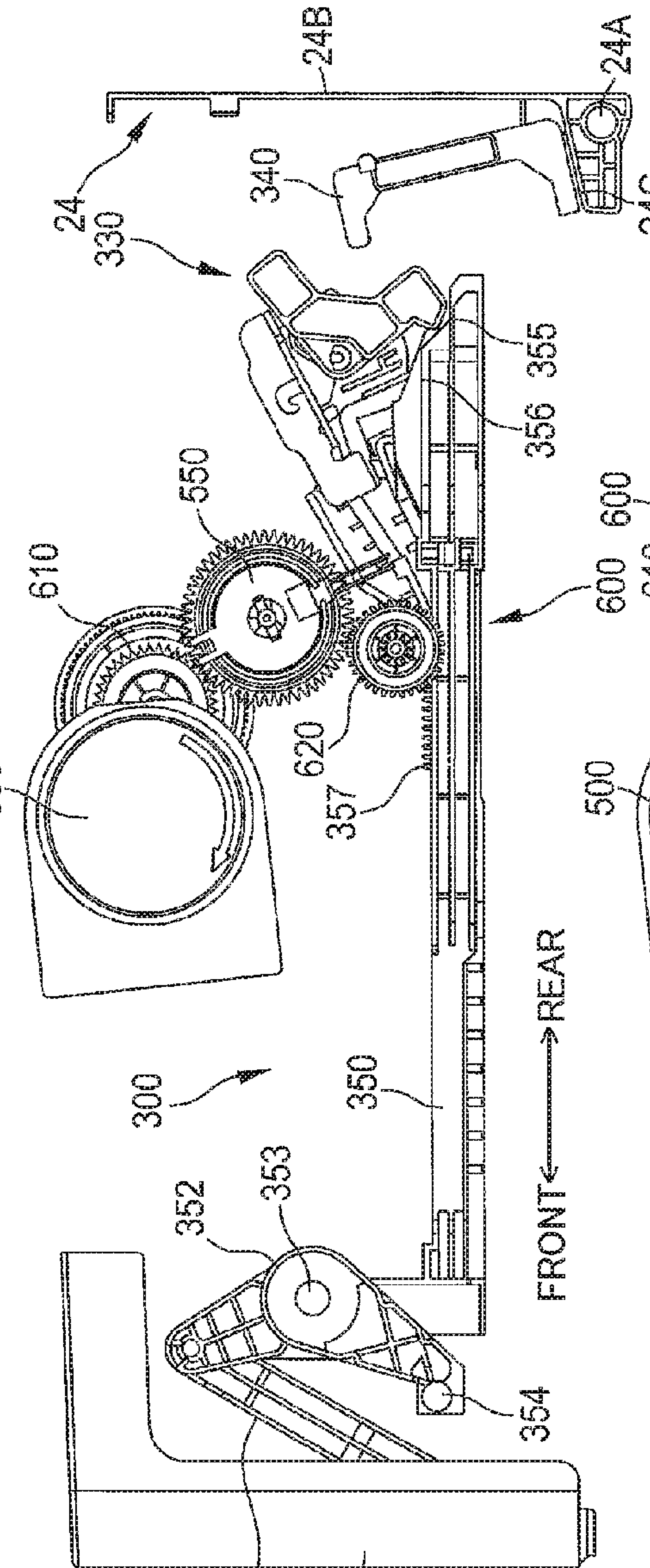

24B
24A
24
24C
340
330
355
356
550
610
600
620
500
357
300
350
FRONT⟷REAR
352
353
354
351
23

FIG. 9A

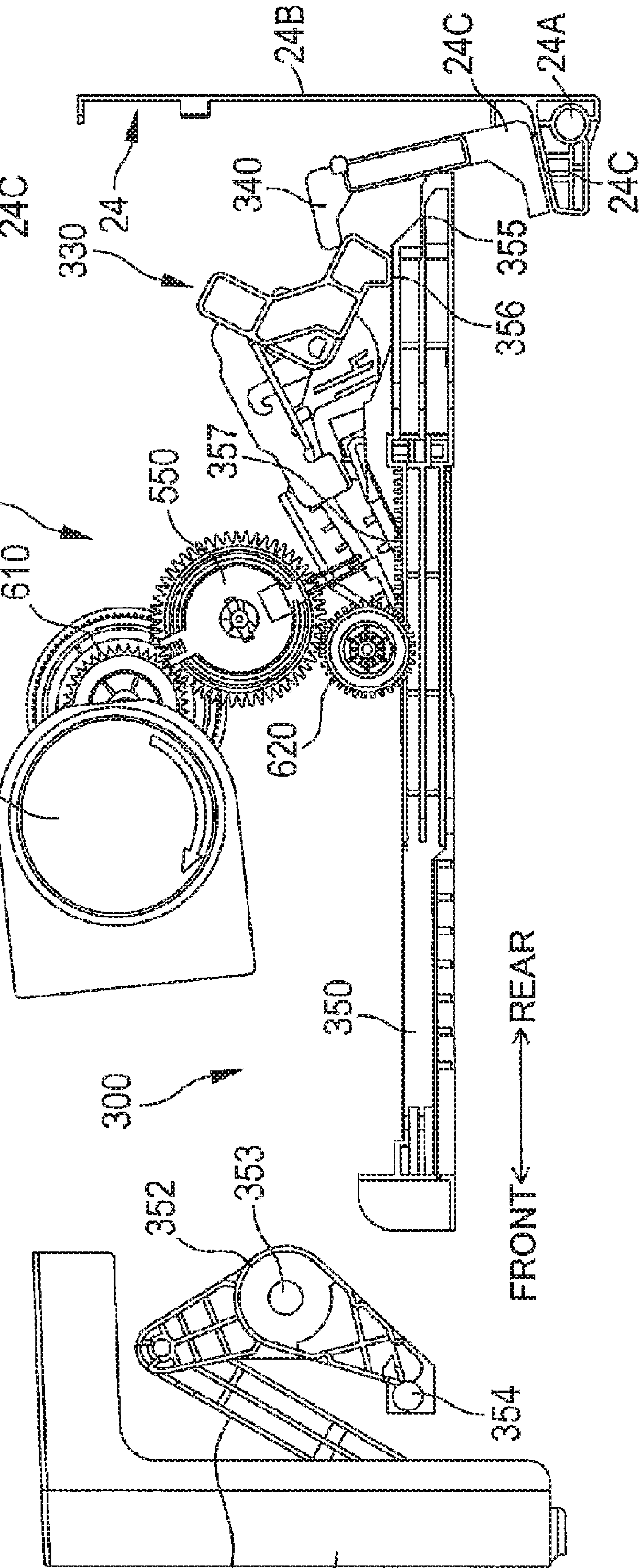

24B
24C
24A
24
340
355
330
356
357
550
600
610
620
500
350
300
FRONT⟷REAR
352
353
354
351
23

FIG. 9B

FIG. 10

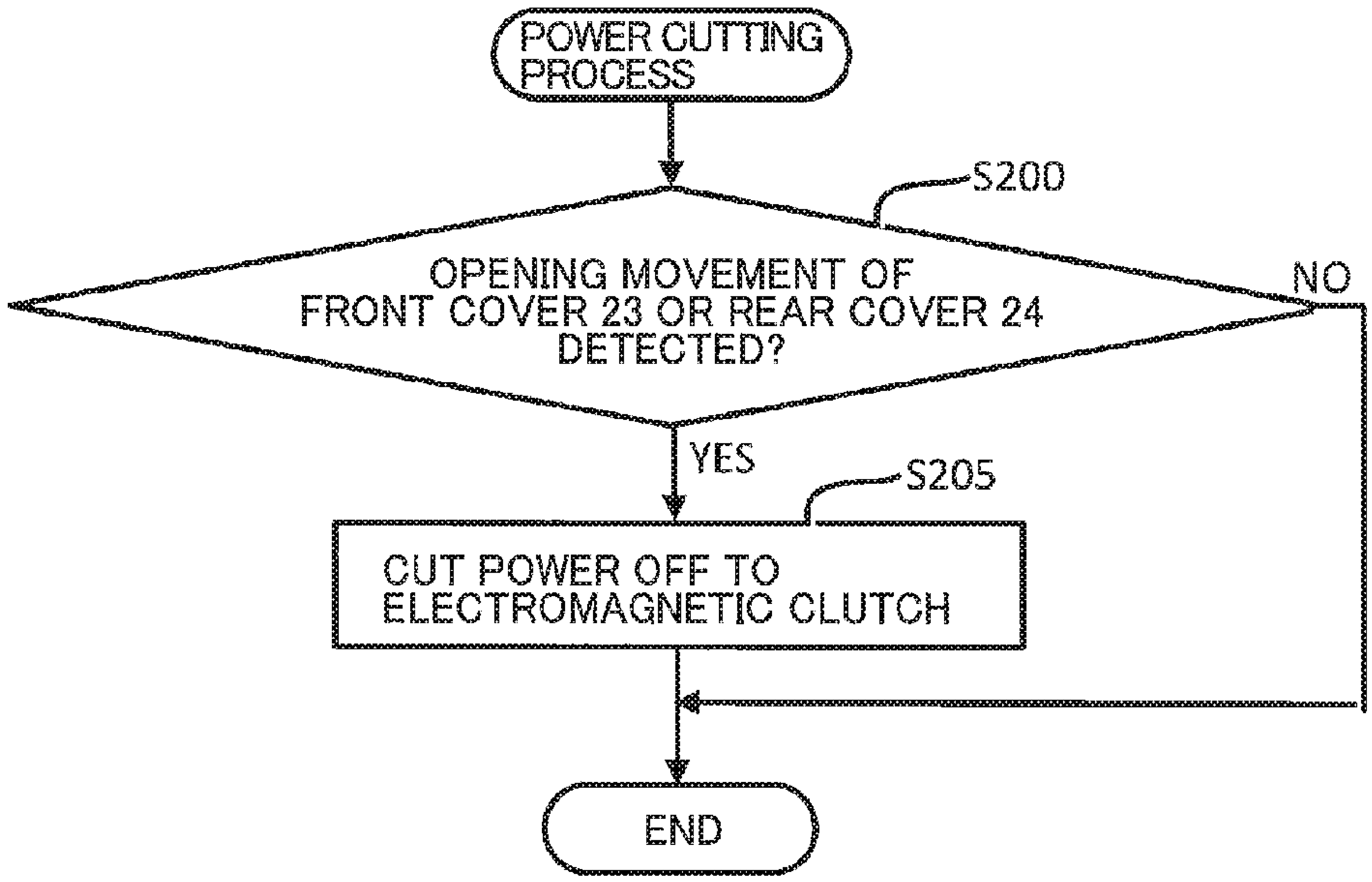

POWER CUTTING PROCESS
S200
OPENING MOVEMENT OF FRONT COVER 23 OR REAR COVER 24 DETECTED?
NO
YES
S205
CUT POWER OFF TO ELECTROMAGNETIC CLUTCH
END

FIG. 11

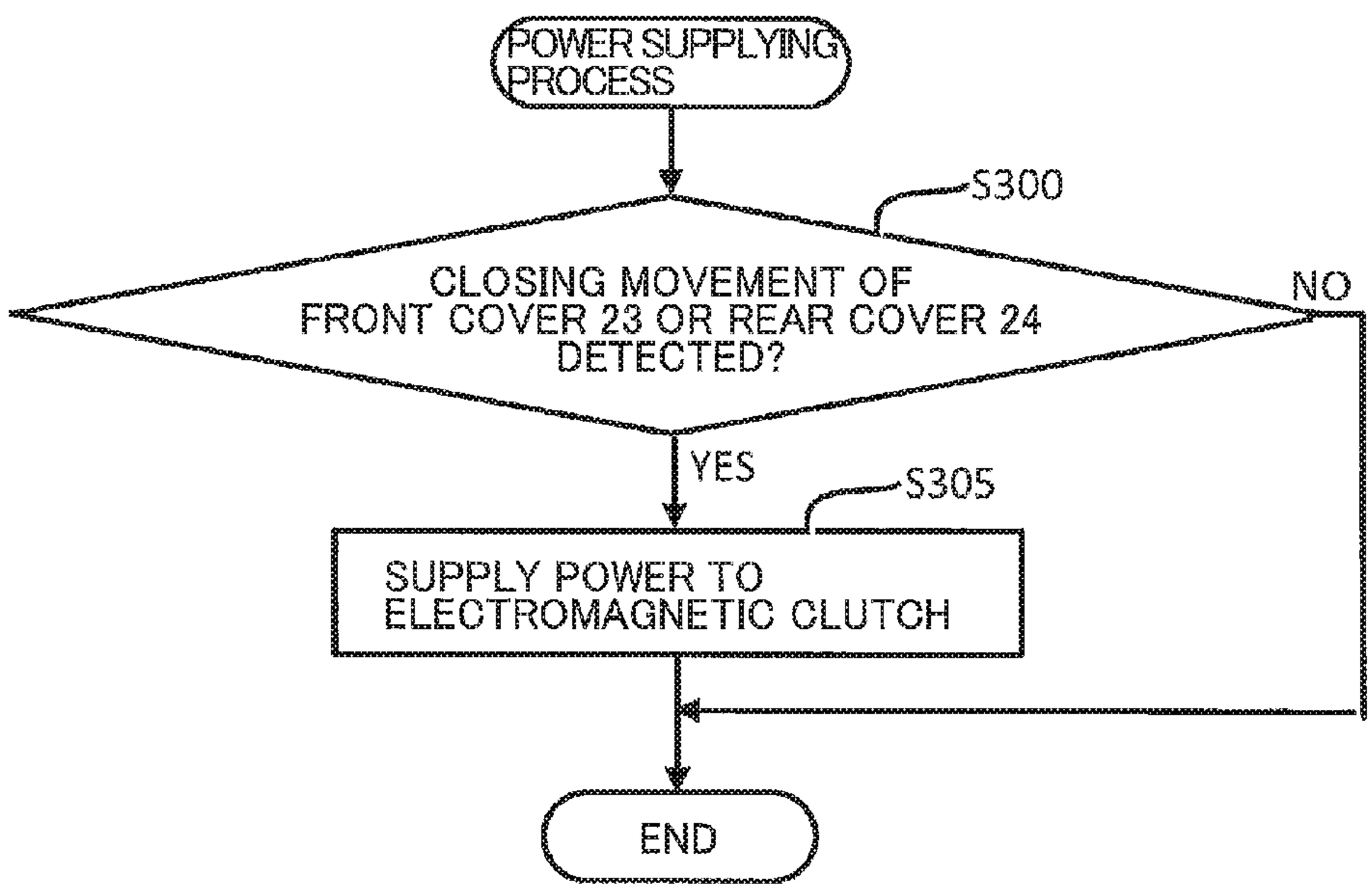

POWER SUPPLYING PROCESS
S300
CLOSING MOVEMENT OF FRONT COVER 23 OR REAR COVER 24 DETECTED?
NO
YES
S305
SUPPLY POWER TO ELECTROMAGNETIC CLUTCH
END

IMAGE FORMING APPARATUS INCLUDING FIXING DEVICE

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2015-021909 filed Feb. 6, 2015. The entire content of the priority application is incorporated herein by reference.

TECHNICAL FIELD

The present disclosure relates to an image forming apparatus including a fixing device.

BACKGROUND

Among the various conventional image forming apparatuses in the art, there are electro-photographic type image forming apparatuses provided with a fixing device for fixing a toner image on a sheet. The image forming apparatus includes a housing, a heat member, and a pressure member in pressure contact with the sheet in cooperation with the heat member. The image forming apparatus is provided with a front cover to cover a front opening of the housing. A nip pressure between the heat member and the pressure member can be changed in interlocking relation to opening/closing motion of the front cover. More specifically the nip pressure at opening state of the front cover is set smaller than the nip pressure at closing state of the front cover for facilitating sheet removal when sheet jamming occurs.

SUMMARY

Recently, improvement on operability to the front cover is required. Specifically, an image forming apparatus capable of decreasing user's burden for opening or closing motion of the front door is required. However, according to the conventional image forming apparatus, the front cover must be opened against urging force of a spring member which urges the heat member toward the pressure member in case where the nip pressure at the open state of the front cover should be lower than the nip pressure at the closed state thereof, i.e., in case where the nip pressure has to be changed. Therefore, opening or closing operation of the front cover may place a burden on the user as changing the nip pressure.

It is therefore an object of the present disclosure to provide an image forming apparatus capable of reducing the burden caused by opening or closing operation of the front cover.

According to one aspect, an image forming apparatus includes, a housing, a nip member, a conveying member, an urging member, a changing portion, an opening/closing member, a first transmission portion, a motor, a second transmission portion, and a switching member. The housing is formed with an opening. The conveying member is configured to convey a recording sheet. The nip member has a nip portion configured to nip the recording sheet in cooperation with the conveying member. The urging member is configured to urge one of the conveying member and the nip member toward another of the conveying member and the nip member. The changing portion is configured to change an urging force of the urging member. The opening/closing member is configured to move between an opening position to uncover the opening and a closing position to cover the opening. The opening/closing member is configured to generate a moving force when being moved. The first transmission portion is configured to be moved by the moving force and transmit the moving three to the changing portion. The motor is configured to generate a drive force. The second transmission portion is configured to transmit the drive force to the first transmission portion to generate the moving force. The switching member is configured to switch to one of a transmitting state and a cutoff state. The switching member interrupts the transmission of the drive force from the second transmission portion to the first transmission portion in the cutoff state. The second transmission portion transmits the drive force to the first transmission portion in the transmitting state.

BRIEF DESCRIPTION OF THE DRAWINGS

The particular features and advantages of the disclosure will become apparent from the following description taken in connection with the accompanying drawings, in which:

FIG. **1** is a schematic cross-sectional view of an image forming apparatus according to an embodiment;

FIG. **2** is a block diagram showing an electrical structure of a control unit in the image forming apparatus according to the embodiment;

FIG. **3** is a schematic cross-sectional view of a fixing unit in the image forming apparatus according to the embodiment;

FIG. **4** is a perspective view of a pressure mechanism in the image forming apparatus according to the embodiment;

FIG. **5**A is a schematic cross-sectional view of the fixing unit and showing a state where high nip pressure is generated;

FIG. **5**B is a schematic cross-sectional view of the fixing unit and showing a state where low nip pressure is generated;

FIG. **5**C is a schematic cross-sectional view of the fixing unit and showing a state where nip pressure is not generated;

FIG. **6** is a view of an interlocking mechanism in a state where a front cover and a rear cover are closed in the image forming apparatus according to the embodiment;

FIG. **7**A is a view of the interlocking mechanism in a state where the front cover is closed and the rear cover is opened in the image forming apparatus according to the embodiment;

FIG. **7**B is a view of the interlocking mechanism in a state where the front cover is opened and the rear cover is closed in the image forming apparatus according to the embodiment;

FIG. **8** is a flowchart showing a process for changing nip pressure in the image forming apparatus according to the embodiment;

FIG. **9**A is a view of the interlocking mechanism in a state where low nip pressure is generated by way of driving force from a motor in the image forming apparatus according to the embodiment;

FIG. **9**B is a view of the interlocking mechanism in a state where nip pressure is not generated by way of driving force from the motor in the image forming apparatus according to the embodiment;

FIG. **10** is a flowchart showing power cutting process in the image forming apparatus according to the embodiment; and

FIG. **11** is a flowchart showing power supplying process in the image forming apparatus according to the embodiment.

DETAILED DESCRIPTION

An overall structure of an image forming apparatus, i.e., a printer **1** according to an embodiment will be described with reference to FIG. **1**. Then, specific structure in the embodiment will be described with reference to FIGS. **2** through **11**. In the drawings, directions will be based on an assumption that the printer **1** is disposed in an orientation in which it is intended to be used. Specifically, the left side of the printer **1** in FIG. **1** will be called the "front," the right side will be called the "rear," the near side will be called the "right," and the far side will be called the "left."

As shown in FIG. **1**, the printer **1** includes a casing **2**. Within the casing **2**, provided are a feeder unit **3** for supplying a sheet P (recording sheet), an image forming unit **4** for forming an image on the sheet, a control unit **50** (see FIG. **2**), and an interlocking mechanism **300** (see FIG. **6**).

The feeder unit **3** includes a sheet supply tray **31** detachably provided in a lower portion of the casing **2**, and a sheet supplying mechanism **32** for supplying the sheet P in the sheet supply tray **31** toward the image forming unit **4**.

The image forming unit **4** includes a scanner unit **5**, a process unit **6**, a transfer roller TR, and a fixing unit **100**.

The scanner unit **5** is provided in an upper portion of the casing **2**. Although not shown in the drawings, the scanner unit **5** includes a laser light-emitting unit, a polygon mirror, lenses, and reflecting mirrors. The scanner unit **5** is configured to irradiate laser beam (indicated by dotted chain lines in FIG. **1**) to expose a surface of a photosensitive drum **81** (described later) to light by way of high speed scanning.

The process unit **6** is attachable to and detachable from the casing **2** and is positioned between a front cover **23** (described later) and the fixing unit **100**. The process unit **6** includes a drum cartridge **8** including the photosensitive drum **81** and a developing cartridge **9** including a developing roller **91** and containing a toner.

In the process unit **6**, a surface of the rotating photosensitive drum **81** is uniformly charged by a charger (not shown), after which the scanner unit **5** irradiates laser beam to expose surface of the photosensitive drum **81** to light at high speed scanning. Thus, a potential of an exposed area is lowered to form an electrostatic latent image on the surface of the photosensitive drum **81** on the basis of the image data.

Then, toner accommodated in the developing cartridge **9** is supplied to the electrostatic latent image formed on the photosensitive drum **81** by the rotating developing roller **91**. Thus, the electrostatic latent image becomes a visible toner image on the surface of the photosensitive drum **81**. Then, the sheet P is conveyed between the photosensitive drums **81** and the transfer roller TR, so that the toner image formed on the photosensitive drums **81** is transferred to the sheet P.

The fixing unit **100** is disposed rearward of the process unit **6**. The toner image transferred onto the sheet P is thermally fixed upon the sheet being passed through the fixing unit **100**. Thereafter, the sheet P is conveyed to a discharge roller R positioned downstream of the fixing unit **100** in a sheet conveying direction, and is then conveyed to a discharge tray **21** by the discharge roller R.

The casing **2** is formed with a first opening **2**A at a position rearward of the fixing unit **100** and a second opening **2**B independent of the first opening **2**A at a position frontward of the process unit **6**. A rear cover **24** is supported to the casing **2** and is pivotally movable about a pivot axis to an open position opening the first opening **2**A and to a closed position closing the first opening **2**A. Further, the front cover **23** as an example of the opening/closing member is supported to the casing **2** and is pivotally movable about a pivot axis to an open position opening the second opening **2**B and to a closed position closing the second opening **2**B.

Further, interlock switches **700**, **701** (FIG. **2**) as examples of a position detector are provided in the casing **2** for detecting positions of the front cover **23** and the rear cover **24**. Each of the interlock switches **700**, **701** is a conventional micro-switch in which an internal terminal is rendered ON and OFF upon application of pressure to a lever (not shown). In the depicted embodiment, the interlock switches **700**, **701** are pressed by a part of the front cover **23** and a part of the rear cover **24**, respectively.

Upon release of the pressure application to the levers, the control unit **50** detects that the front cover **23** or the rear cover **24** is at position other than closed position. On the other hand, upon application of the pressure to each of the levers, the control unit **50** detects that the front cover **23** and the rear cover **24** are at the closed positions. Incidentally, in the present specification, movement of the front and rear covers from their closed positions will be referred to as "opening movement", and movement of the front and rear covers from their open positions will be referred to as "closing movement."

In the present embodiment, positions of the front cover **23** and the rear cover **24** are detected by the interlock switches **700**, **701**. However, instead of the interlock switches, conventional optical sensors may be used for detecting positions of the covers **23**, **24**.

Next, electrical structure of the control unit **50** will be described. As shown in FIG. **2**, the control unit **50** includes a CPU **51**, a ROM **52**, a RAM **53**, and a NVRAM **54**. The control unit **50** is electrically connected to a motor **500**, an electromagnetic clutch **550**, and the interlock switches **700**, **701**.

The ROM **52** is configured to store various control programs for controlling the printer **1**, image processing program, various setting, and initial value.

The RAM **53** provides a working region into which various control programs are retrieved, and a storing region in which print data or image data transmitted through various interfaces is temporarily stored.

The NVRAM **54** is a storing member having non-volatile property and is used as a storing region in which various settings and print data are stored.

The CPU **51** is configured to control various components of the printer **1** while allowing the processing result to be stored in the RAM **53** and the NVRAM **54** in accordance with a control program retrieved from the ROM **52**.

Detection signal is transmitted to the control unit **50** upon detection of the closed position of the front cover **23** and the rear cover **24** by the interlock switches **700** and **701**.

The fixing unit **100** will next be described in detail. As shown in FIG. **3**, the fixing unit **100** includes a fixing film **110** which is detachably attached to the casing **2** and is an example of a nip member, a halogen lamp **120**, a nip plate **130**, a reflection plate **140**, a pressure roller **150** as an example of a conveying member, a stay **160**, and a pressure mechanism **200** (see FIG. **4**).

The fixing film **110** is in a form of an endless (tubular) film providing heat resistivity and flexibility. The fixing film **110** has each end guided by guide members **170** (described later) which guide circular movement of the fixing film **110**.

The halogen lamp **120** is a typical example of the heater for heating the nip plate **130** and the fixing film **110** thereby heating toner on the sheet P. The halogen lamp **120** is positioned at an internal space of the fixing film **110**, and is spaced apart at a prescribed distance from inner surfaces of the fixing film **110** and the nip plate **130**.

The nip plate **130** is a plate-like member and is configured to receive radiant heat from the halogen lamp **120**, and is configured to be in sliding contact with the inner surface of the tubular fixing film **110**. The nip plate **130** transmits radiant heat received from the halogen lamp **120** to the toner on the sheet P through the fixing film **110**. The fixing film **110** and the pressure roller **150** nip the sheet P therebetween for conveying the sheet P and for fixing a toner image to the sheet P by the radiant heat received from the halogen lamp **120**.

The reflection plate **140** is a member for reflecting radiant heat from the halogen lamp **120** toward an upper surface of the nip plate **130**. The reflection plate **140** is spaced apart from the halogen lamp **120** by a predetermined distance.

The pressure roller **150** is disposed below the nip plate **130** so as to nip the fixing film **110** in cooperation with the nip plate **130**, while the pressure roller **150** is rotated and is pressed toward the nip plate **130**. A nip region N1 is formed by the pressure contact between the pressure roller **150** and the fixing film **110**.

As shown in FIG. **1**, the pressure roller **150** is connected to a drive source M through a transmission mechanism **151** (described later). The pressure roller **150** is rotationally driven upon input of drive force from the drive source M. Thus, fixing film **110** in pressure contact with the pressure roller **150** is driven.

The transmission mechanism **151** includes a drive gear **152** and a one-way clutch **153**. The drive gear **152** is fixed to a rotation shaft of the pressure roller **150**. The one-way clutch **153** includes a small diameter gear **154** in meshing engagement with the drive gear **152**, a large diameter gear **155** in meshing engagement with the drive source M, and a clutch mechanism (not shown) provided between the small diameter gear **154** and the large diameter gear **155**.

The clutch mechanism is configured to rotate the small diameter gear **154** in a counterclockwise direction by the transmission of the driving force of the large diameter gear **155** to the small diameter gear **154** upon counterclockwise rotation of the large diameter gear **155** as a result of driving of the drive source M. Thus, the pressure roller **150** can be rotated in the counterclockwise direction in FIG. **1**.

As shown in FIG. **3**, the stay **160** supports front and rear end portions of the nip plate **130** through flange portions **142** of the reflection plate **140** for ensuring rigidity of the nip plate **130**.

As illustrated in FIG. **4**, guide members **170** are formed at both left and right end portions of the fixing unit **100**, respectively. The guide members **170** support upper portions of left and right end portions of the stay **160**. The guide members **170** are positioned adjacent to the left and right end portions of the fixing film **110** and mainly regulate movement of the fixing film **110** in the leftward/rightward direction.

The pressing mechanism **200** mainly includes a fixing frame **210**, a support plate **220**, and coil springs S as examples of the urging member. The pressing mechanism **200** is provided at both left and right end portions of the fixing unit **100**.

The fixing frame **210** rotatably supports the pressure roller **150** and supports the guide members **170** movably with respect to the pressure roller **150**. Specifically, the fixing frame **210** has left and right side walls, and the left and right side walls are provided with grooves (not illustrated) that support the pressure roller **150**. Further, the left and right side walls of the fixing frame **210** are provided with other grooves (not illustrated) that movably support the guide members **170** in the upward/downward direction.

The support plates **220** are fixed to upper surfaces of the guide members **170** and each support plate **220** has a bent shape extending rearward.

The coil springs S are provided between the support plates **220** and upper walls of the fixing frame **210**. The coil springs S urge the support plates **220** and the guide members **170** downward, thereby causing the nip plate **130** and the fixing film **110** to be biased toward the pressure roller **150**.

In the present embodiment, the coil springs S urge the fixing film **110** toward the pressure roller **150**. Alternatively, the coil springs S may urge the pressure roller **150** toward the fixing film **110**.

Accordingly, a suitable nip pressure is applied between the fixing film **110** and the pressure roller **150**. The nip pressure in the present specification refers to a pressure at a nip area. Hereinafter, a pressure at a nip area N1 in a state where the nip plate **130** is at a first position in FIG. **5**A is referred to as “strong nip”.

As illustrated in FIG. **4**, cams **320** are provided below rear end portions of the support plates **220**. The cams **320** are fixed at left and right end portions of a shaft **310** extending in the leftward/rightward direction and can abut against the support plates **220** from below to push up the support plates **220**. The shaft **310** is rotatably supported by the fixing frame **210**.

An arm member **330**, as an example of the changing portion, formed into a substantially L-shape is pivotably fixed to a right end portion of the shaft **310**, which is inserted to the arm member **330**. The shaft **310** and the left and right cams **320** are integrally pivotable in conjunction with the pivot of the arm member **330**.

When the arm member **330** pivots, each cam **320** is conjunctively pivoted and abuts against the each rear end portion of the support plates **220** to thereby push up the support plates **220**. When the support plates **220** are pushed up, each of the left and right guide members **170** is moved up against the urging force of the coil springs S. As described above, the pivot of the arm member **330** acts on the coil springs S through the cams **320** and the support plates **220** to change the urging force of the coil spring S.

As described above, the pivot of the arm member **330** moves the guide members **170** up and down with respect to the fixing frame **210**, thereby moving up and down the nip plate **130** supported by the guide members **170** with respect to the pressure roller **150**. Accordingly, the nip pressure can be changed.

In the present embodiment, the fixing film **110** and the pressure roller **150** are used to fix a toner image. Alternatively, a conventional heating roller and a pressure roller may be used to fix a toner image.

As illustrated in FIG. **6**, the interlocking mechanism **300** is provided in the casing **2**. The interlocking mechanism **300** is a mechanism for changing the nip pressure in conjunction with opening and closing operations of the front cover **23**. The following describes in detail the interlocking mechanism **300**.

The interlocking mechanism **300** mainly includes a slide member **340**, a push-up part **24**C, a linear motion member **350** as an example of the first transmission portion, a first link **351**, and a second link **352**. The first link **351** and the second link **352** are examples of a link member.

The slide member **340** is a member substantially extending in the upward/downward direction and is disposed between the arm member **330** and the push-up part **24**C. The slide member **340** is supported by the casing **2** so as to be slidable in a longitudinal direction thereof.

The push-up part **24**C is formed so as to extend in a direction perpendicular to the cover body **24**B from a pivot center **24**A of the rear cover **24** and abuts against a lower end portion of the slide member **340**. As illustrated in FIG. **7**A, the push-up part **24**C pushes up the slide member **340** during the opening operation of the rear cover **24**, causing the slide member **340** to be slid upward. When the slide member **340** is slid upward, an upper end portion of the slide member **340** abuts against the arm member **330**, causing the arm member **330** to be rotated in the counterclockwise direction in the drawing.

When the rear cover **24** is closed in this state, the slide member **340** is slid downward. Then, in conjunction with the slide movement, the arm member **330** is rotated in the clockwise direction in the drawing by the urging force of the coil springs S to return to its original position.

In a state illustrated in FIG. **7**A where the rear cover **24** is fully opened, the slide member **340** is positioned at the topmost position to cause each of the left and right cams **320** to push up the support plate **220**. In this state, as illustrated in FIG. **5**B, the nip plate **130** is at a second position separated more from the pressure roller **150** in the upward direction than a first position in FIG. **5**A, and forms a nip area N**2** between the pressure roller **150** and the fixing film **110**. The pressure at the nip area N**2** is defined as "weak nip" which is lower pressure than the strong nip.

As illustrated in FIG. **6**, the linear motion member **350** is a rod-like member extending in the frontward/rearward direction and is disposed between the front cover **23** and the arm member **330**. The linear motion member **350** is a member for changing the nip pressure in conjunction with the opening operation of the front cover **23**. A front end portion of the linear motion member **350** is connected to the front cover **23** via first and second links **351** and **352**.

The first link **351** is formed into a long-rod shape and pivotably connected to the front cover **23**.

The second link **352** is disposed between the first link **351** and the linear motion member **350** and pivotably supported by the casing **2**. The second link **352** is pivotable about a link shaft **353**, which rotatably supports the second link **352**. One end of the second link **352** is pivotably connected to the first link **351**, and the other end has an extension part **354** extending in the leftward/rightward direction from the second link **352**. The extension part **354** abuts against the front end portion of the linear motion member **350** in a state where the front cover **23** and the rear cover **24** are closed.

As illustrated in FIG. **7**B, when the front cover **23** is opened, the first link **351** is moved forward. In conjunction with this movement, the second link **352** is rotated in the counterclockwise direction in the drawing to push rearward the linear motion member **350** through the extension part **354** formed at the other end of the second link **352**.

As described above, when the second link **352** is rotated in the counterclockwise direction in the drawing in conjunction with the movement of the front cover **23**, the linear motion member **350** is linearly moved rearward. As a result, the arm member **330** abuts against first and second abutment parts **355** and **356** which are formed at a rear end portion of the linear motion member **350**. The first and second abutment parts **355** and **356** are examples of the first abutment portion.

The first and second abutment parts **355** and **356** are each formed into a flat surface extending in the frontward/rearward direction. The first abutment part **355** is positioned downward of the second abutment part **356**. The first and second abutment parts **355** and **356** abut against a lower end portion of the arm member **330** from below to rotate the arm member **330** in the counterclockwise direction.

In a state illustrated in FIG. **7**B where the front cover **23** is fully opened, the linear motion member **350** is positioned at the rearmost position. In this state, the arm member **330** and the second abutment part **356** abut against each other, and each of the left and right cams **320** pushes up the support plate **220**. Further, in this state, as illustrated in FIG. **5**C, the nip plate **130** is positioned at a third position separated more from the pressure roller **150** in the upward direction than the second position in FIG. **5**B. As a result, no nip pressure is applied between the pressure roller **150** and the fixing film **110**.

In the present embodiment, in the full-open state of the front cover **23**, no nip pressure is applied between the pressure roller **150** and the fixing film **110**. Alternatively, a predetermined nip pressure may be applied between the pressure roller **150** and the fixing film **110** (referred to as a "non-pressure state", hereinafter).

The following describes an example of operation of the printer **1**. When printing is performed with the front cover **23** and the rear cover **24** closed, a sheet P is conveyed to the nip area N**1** at which the nip pressure is the strong nip, and a toner image is thermally fixed onto the sheet P.

When printing is performed for a thick paper as an example of the recording sheet, such as an envelope thicker than the sheet P, the rear cover **24** is opened as illustrated in FIG. **7**A. At this time, the nip area N**2** having a lower nip pressure than the nip area N**1** is formed, so that the image can be thermally fixed onto a thick paper such as an envelope under a suitable nip pressure. Then, the thick paper that has passed through the fixing unit **100** is not fed to the discharge roller R, and is discharged from the first opening portion **2**A to be placed on the rear cover **24**.

For example, when a jam occurs inside the fixing unit **100** in a state where printing is performed with the front cover **23** and the rear cover **24** closed, a user opens the front cover **23** and takes the process unit **6** out of the casing **2**. At this time, the nip plate **130** is positioned at the third position (FIG. **5**C) separated from the pressure roller **150**, and thus the sheet P is not held between the fixing film **110** and the pressure roller **150**, so that the sheet P can easily be pulled out.

As described above, when printing is performed for a thick paper or the like, or when jam processing is performed, it is necessary to rotate the arm member **330** against the urging force of the coil springs S through the front cover **23** and the rear cover **24**.

Thus, in the present embodiment, in order to improve the operability of the front cover **23**, the printer **1** includes the motor **500**, the electromagnetic clutch **550** as an example of the switching member, and a motor transmission mechanism **600** as the second transmission portion. The motor transmission mechanism **600** transmits a drive force of the motor **500** to the linear motion member **350** to allow the nip pressure to be changed by the drive force of the motor **500**.

As illustrated in FIG. **6**, the motor **500** is provided inside the casing **2**. The motor transmission mechanism **600** includes a first gear **610** meshing with the motor **500** and a second gear **620** meshing with a gear part **357** formed on an upper surface of the linear motion member **350**.

The electromagnetic clutch **550** is disposed between the first gear **610** and the second gear **620**. The electromagnetic clutch **550** is a conventional electromagnetic clutch and meshes with the first and second gears **610** and **620**.

The electromagnetic clutch **550** provides a transmission state and a cutoff state. In the transmission state, the motor transmission mechanism **600** transmits the drive force of the motor **500** to the linear motion member **350**. In the cutoff state, the motor transmission mechanism **600** does not transmit the drive force of the motor **500** to the linear motion member **350**. Specifically, when the electromagnetic clutch **550** is powered, the electromagnetic clutch **550** transmits the drive force of the motor **500** from the first gear **610** to the second gear **620**. When power to the electromagnetic clutch **550** is cut off, the electromagnetic clutch **550** does not transmit the drive force of the motor **500** between the first gear **610** and the second gear **620**.

When power to the electromagnetic clutch **550** is cut off, the electromagnetic clutch **550** idles. As a result, the first gear **610** and the second gear **620** are in an idle state.

In the present embodiment, the electromagnetic clutch **550** is used to switch between the transmission state and the cutoff state. Alternatively, a conventional swing gear that can swing between the transmission state and the cutoff state may be used.

The following describes in detail a nip pressure change process that the control unit **50** executes. In the nip pressure change process, rotation of the motor **500** is controlled. The control unit **50** executes the nip pressure processing at a predetermined time interval.

As illustrated in FIG. **8**, in the nip pressure change process, the control unit **50** determines whether it is a timing to change the nip pressure (S**100**). When determining that it is a timing to change the nip pressure (YES in S**100**), the control unit **50** rotates the motor **500** (S**105**) and supplies power to the electromagnetic clutch **550** (S**110**).

In S**105**, when lowering the nip pressure, the control unit **50** drives the motor **500** in the clockwise direction in FIG. **6**. Otherwise, when increasing the nip pressure, the control unit **50** drives the motor **500** in the counterclockwise direction. The nip pressure change timing is, for example, a time when a jam occurs or a time during a conventional warming up operation, which is usually performed immediately after power-ON operation.

As illustrated in FIG. **8**, the control unit **50** determines whether a predetermined time has elapsed after supplying power to the electromagnetic clutch **550** in S**110** (S**115**). When determining that a predetermined time has elapsed (YES in S**115**), the control unit **50** cuts off power to the electromagnetic clutch **550** (S**120**), stops rotating the motor **500** (S**125**), and ends the nip pressure change process.

When determining that a predetermined time has not elapsed (NO in S**115**), the control unit **50** repeats the step S**115**. The predetermined time in S**115** may be an arbitrary time period required to move the linear motion member **350** for changing the nip pressure.

Inside the casing **2**, three conventional sensors for detecting a position of the linear motion member **350** in the frontward/rearward direction are arranged at a predetermined interval from one another in the frontward/rearward direction. The three sensors are provided corresponding to different nip pressures and arranged at a predetermined interval so as to detect ribs formed in the linear motion member **350** (not illustrated). When detecting the rib, each of the three sensors outputs a detection signal to the control unit **50**. With this configuration, the control unit **50** can detect a nip pressure application state on the basis of the detection signal from each of the three sensors.

In S**115**, the control unit **50** uses, as the predetermined time, a time corresponding to the nip pressure application state. Specifically, the predetermined time used during changing the nip pressure from the strong nip to the weak nip is shorter than a predetermined time during changing the nip pressure from the strong nip to the non-pressure state.

When determining in S**100** that it is not a timing to change the nip pressure (NO in S**100**), the control unit **50** ends the nip pressure change process.

The following describes operation of the linear motion member **350** when the control unit **50** executes the nip pressure change process in a state as illustrated in FIG. **6**, where the front cover **23** and the rear cover **24** are closed and the strong nip is applied.

When the motor **500** is driven in the clockwise direction and the electromagnetic clutch **550** is powered in a state illustrated in FIG. **6** where the strong nip is applied, the second gear **620** is rotated in the counterclockwise direction in the drawing. Then, the linear motion member **350** is moved rearward in conjunction with the rotation of the second gear **620**, which is inter locked with the linear motion member **350**.

When the linear motion member **350** is moved rearward by a predetermined distance, the first abutment part **355** and the arm member **330** abut against each other as illustrated in FIG. **9**A, thereby changing the nip pressure to the weak nip. Then, the control unit **50** cuts off power to the electromagnetic clutch **550**, and the drive force of the motor **500** is not transmitted to the second gear **620**. As a result, the rearward movement of the linear motion member **350** is stopped. Thus, the weak nip is maintained.

In this state, a direction of the force transmitted from the coil springs S to the linear motion member **350** through the arm member **330** is perpendicular to the moving direction of the linear motion member **350**. Accordingly, the linear motion member **350** is prevented from being moved by the urging force of the coil springs S, when the control unit **50** cuts off power to the electromagnetic clutch **550**. As a result, even when the control unit **50** cuts off power to the electromagnetic clutch **550**, the application of the weak nip can be maintained.

In addition to this state, if the control unit **50** supplies power to the electromagnetic clutch **550** to move the linear motion member **350** rearward by a predetermined distance from a position illustrated in FIG. **9**A, the second abutment part **356** and the arm member **330** abut against each other, as illustrated in FIG. **9**B. As a result, the nip pressure is changed to the non-pressure state.

As described above, the motor transmission mechanism **600** provided with the first and second gears **610** and **620** transmits the drive force of the motor **500** to the linear motion member **350**, thereby moving the linear motion member **350** and changing the nip pressure. As a result, the nip pressure can be changed without intervention of user's operation.

Further, the cutoff of power to the electromagnetic clutch **550** interrupts a drive transmission path between the motor **500** and the linear motion member **350**, so that a force required to move the linear motion member **350** can be reduced as compared to a case where the drive transmission path is not interrupted. This can also reduce the force required to move the front cover **23**, thereby reducing a burden associated with opening/closing operations of the front cover **23** for changing the nip pressure.

Further, in the present embodiment, the movement of the front cover **23** and the drive force of the motor **500** are transmitted to the arm member **330** to thereby change the nip pressure by commonly employing the linear motion member **350**. By sharing the mechanism for changing the nip pressure as described above, the dimension of the printer **1** can be reduced.

In a state as illustrated in FIG. **9**B, where no nip pressure is applied, the lower end portion of the arm member **330** abuts against the second abutment part **356** in a horizontal posture. Accordingly, the direction of the force transmitted from the coil springs S to the linear motion member **350** through the arm member **330** is perpendicular to the moving direction of the linear motion member **350**. The linear motion member **350** is therefore prevented from being moved by the urging force of the coil springs S, when the control unit **50** cuts off power to the electromagnetic clutch **550**. As a result, even when the control unit **50** cuts off power to the electromagnetic clutch **550**, the non-pressure state can be maintained.

In the state illustrated in FIG. **9**B, where no nip pressure is applied, if the motor **500** is rotated in the counterclockwise direction in the drawing and the electromagnetic clutch **550** is powered, the second gear **620** is rotated in the clockwise direction in the drawing. Then, the linear motion member **350** is moved forward in conjunction with the rotation of the second gear **620**, which is interlocked with the linear motion member **350**.

When the linear motion member **350** is moved forward by a predetermined distance, the nip pressure is increased to the weak nip as illustrated in FIG. **9**A. Then, the control unit **50** cuts off power to the electromagnetic clutch **550**, and the forward movement of the linear motion member **350** is stopped, so that the weak nip application state is maintained.

Further, if the control unit **50** supplies power to the electromagnetic clutch **550** to move the linear motion member **350** forward by a predetermined distance from a position illustrated in FIG. **9**A, the nip pressure is increased to the strong nip as illustrated in FIG. **6**. Then, the control unit **50** cuts off power to the electromagnetic clutch **550**, and the application of the strong nip is therefore maintained.

As described above, in the present embodiment, the nip pressure can be changed by the drive force of the motor **500** and the opening operation of the front cover **23** or the rear cover **24**. Thus, when the motor **500** cannot be driven due to, for example, cut off of power supply to the printer **1**, the nip pressure can be changed by the opening operation of the front cover **23** or the rear cover **24**. Otherwise, when the motor **500** can be driven, the nip pressure can be changed by the drive force of the motor **500**.

However, for example, if the front cover **23** is opened in a state where the electromagnetic clutch **550** is powered, the linear motion member **350**, which is being connected to the motor **500** through the drive transmission path, needs to be pushed rearward. Accordingly, the force required to push the linear motion member **350** is increased as compared to a case where the electromagnetic clutch **550** is not powered. As a result, the force required to open the front cover **23** is increased, so that the operability of the front cover **23** may be deteriorated.

Further, for example, if the front cover **23** is opened in the state illustrated in FIG. **9**B, where the linear motion member **350** has been moved forward by the drive force of the motor **500**, the extension part **354** and the linear motion member **350** may interfere with each other and result in damage of the extension part **354** or the linear motion member **350**.

Thus, in the present embodiment, the control unit **50** executes power cutting process and power supplying process while considering the above problems. The control unit **50** executes the power cutting process and the power supplying process at a predetermined time interval.

As illustrated in FIG. **10**, in the power cutting process, the control unit **50** determines, based on a detection signal outputted from the interlock switch **700** or **701**, whether the opening operation of the front cover **23** or the rear cover **24** has been detected (S**200**). Specifically, the control unit **50** determines that the opening operation of at least one of the front cover **23** and the rear cover **24** has been detected, when the signal from the interlock switch **700** or **701** to the control unit **50** is changed to an undetected state from a detected state.

When determining in S**200** that opening operation of at least one of the front cover **23** and the rear cover **24** has been detected (YES in S**200**), the control unit **50** cuts off power to the electromagnetic clutch **550** (S**205**) and ends the power cutting process.

When determining in S**200** that opening operation of the front cover **23** or the rear cover **24** has not been detected (No in S**200**), the control unit **50** ends the power cutting process.

As described above, when detecting the opening operation of at least one of the front cover **23** and the rear cover **24**, the control unit **50** cuts off power to the electromagnetic clutch **550** to interrupt the drive transmission path between the motor **500** and the linear motion member **350**. Thus, the force required to move the linear motion member **350** can be reduced as compared to a case where the drive transmission path is not interrupted. Accordingly, the three required to open or close the front cover **23** can be reduced, and the burden associated with opening or closing the front cover **23** to change the nip pressure is therefore reduced.

In the present embodiment, the control unit **50** cuts off power to the electromagnetic clutch **550**. Alternatively, each of the interlock switches **700** and **701** may have a conventional cutoff mechanism that cuts off power to the electromagnetic clutch **550**. With this configuration, the interlock switch **700** or **701** cuts off power to the electromagnetic clutch **550** in conjunction with the opening operation of the front cover **23** or the rear cover **24**.

Further, as illustrated in FIG. **11**, in the power supplying process, the control unit **50** determines whether the closing operation of at least one of the front cover **23** and the rear cover **24** has been detected (S**300**). Specifically, the control unit **50** determines that the closing operation of one of the front cover **23** and the rear cover **24** has been detected, when the signal from the interlock switch **700** or **701** to the control unit **50** is changed from the undetected state to the detected state.

When determining in S**300** that closing operation of at least one of the front cover **23** and the rear cover **24** has been detected (YES in S**300**), the control unit **50** supplies power to the electromagnetic clutch **550** (S**305**) and ends the power supplying process.

When determining in S**300** that closing operations of the front cover **23** or the rear cover **24** has not been detected (NO in S**300**), the control unit **50** ends the power supplying process.

As described above, when detecting the opening operation of at least one of the front cover **23** and the rear cover **24**, the control unit **50** cuts off power to the electromagnetic clutch **550**. When detecting the closing operation of at least one of the front cover **23** and the rear cover **24**, the control unit **50** supplies power to the electromagnetic clutch **550**. Accordingly, power to the electromagnetic clutch **550** is reliably cut off during the opening or closing operation of the front cover **23**. Therefore, the drive transmission path between the motor **500** and the linear motion member **350** is reliably interrupted during the opening or closing operation of the front cover **23**, thereby reducing the burden associated with opening or closing operation of the front cover **23** to change the nip pressure.

While the description has been made in detail with reference to specific embodiment thereof, it would be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit and scope of the above described embodiment.

In the above embodiment, the control unit **50** executes the processing steps described above. Alternatively, another

CPU may execute at least some of the steps, or one or more ASICs may execute at least some of the steps.

What is claimed is:

1. An image forming apparatus comprising:

a housing formed with an opening;

a conveying member configured to convey a recording sheet;

a nip member having a nip portion configured to nip the recording sheet in cooperation with the conveying member;

an urging member configured to urge one of the conveying member and the nip member toward another of the conveying member and the nip member;

a changing portion configured to change an urging force of the urging member;

an opening/closing member configured to move between an opening position to uncover the opening and a closing position to cover the opening, the opening/closing member being configured to generate a moving force when being moved;

a first transmission portion configured to be moved by the moving force and transmit the moving force to the changing portion;

a motor configured to generate a drive force;

a second transmission portion configured to transmit the drive force to the first transmission portion to generate the moving force; and

a switching member configured to switch to one of a transmitting state and a cutoff state, the switching member interrupting the transmission of the drive force from the second transmission portion to the first transmission portion in the cutoff state, and the second transmission portion transmitting the drive force to the first transmission portion in the transmitting state.

2. The image forming apparatus according to claim 1, further comprising:

a position detector configured to detect the closing position of the opening/closing member as a detected condition; and

a control unit configured to control the switching member to switch to the cutoff state when the detected condition is changed to an undetected condition where the position detector fails to detect that the opening/closing member is positioned at the closing position.

3. The image forming apparatus according to claim 2, wherein the control unit is configured to control the switching member to switch to the transmitting state when the undetected condition is changed to the detected condition.

4. The image forming apparatus according to claim 1, wherein the switching member comprises an electromagnetic clutch.

5. The image forming apparatus according to claim 1, wherein the changing portion comprises an arm member that is pivotably movable and configured to change the urging force in accordance with pivotal movement thereof.

6. The image forming apparatus according to claim 5, wherein the first transmission portion comprises a linear motion member linearly movable in interlocking relation to movement of the opening/closing member.

7. The image forming apparatus according to claim 6, wherein the linear motion member has an abutment portion configured to abut against the arm member to pivotally move the arm member.

8. The image forming apparatus according to claim 7, wherein the linear motion member is movable in a moving direction; and

wherein, when the abutment portion abuts against the arm member to pivotally move the arm member, the urging force transmitted to the linear motion member from the urging member through the arm member is directed in a direction perpendicular to the moving direction.

9. The image forming apparatus according to claim 6, further comprising:

a link member configured to link the opening/closing member to the linear motion member; and

wherein, when the opening/closing member is moved from the closing position to the opening position, the link member transmits the moving force to the linear motion member.

10. The image forming apparatus according to claim 9, wherein one end of the link member is configured to be coupled to the opening/closing member; and

wherein the link member has an abutment portion at the other end thereof configured to abut against the linear motion member to transmit the moving force to the linear motion member and linearly move the linear motion member.

11. The image forming apparatus according to claim 6, wherein the linear motion member has a gear part formed on a surface thereof; and

wherein the second transmission portion comprises a gear mechanism configured to mesh with the gear part; and

wherein the switching member is configured to interrupt transmission of the drive force from the motor to the gear mechanism in the cutoff state and transmit the drive force from the motor to the gear mechanism in the transmitting state.

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